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Beech Utilization Series No. 19

Availability of Beech in the Northeast

by

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Northeastern Technical Committee
On The Utilization Of Beech

in cooperation with

Northeastern Forest Experiment Station
Forest Service, U. S. Dept. of Agriculture

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FOREWORD

The wood of the American beech tree (Fagus grandifolia Ehrh.) is well suited for a large number of uses, and it is rather widely used by manufacturers. Yet the amount used is not in proportion to the amount that grows in our northeastern forests. The utilization of beech--both in the woods and in the factory--has been recognized as a problem.

One reason for this is in the nature of the wood: it has a reputation for being difficult to season. Another is that many of the beech trees in our forests are of poor quality. And there are some plain prejudices against beech.

Research is finding ways to utilize beech as efficiently as any of the other comparable hardwoods can be handled. Considerable information about beech has been gathered. Yet most of this information is available only in fragmentary form in scattered technical reports. Some of it has never been published.

To study the problems of putting beech to the uses it deserves, and to promote the better management of the forests in which it grows, a Northeastern Technical Committee on the Utilization of Beech was organized in 1949. This committee, which includes representatives of Federal and State forestry agencies, universities, and state experiment stations, decided to assemble and publish the available information about the utilization of American beech.

As its part of this cooperative project, the Northeastern Forest Experiment Station has undertaken to edit, publish, and distribute the series of reports that will contain this information.

The subjects of these reports will be as follows:

*Physical and mechanical properties of American beech.

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(CONTINUED ON INSIDE OF BACK COVER)

Availability of Beech in the Northeast

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THE USEFULNESS of any raw material depends in part upon its availability. Thus, the usefulness of beech stumpage depends on the answers to such questions as: How much is available? What is its quality? Where is it located? Is it in stands that can be easily logged? Answers to these questions are needed by prospective users of the Northeast's inventory of beech (Fagus grandifolia Ehrh.). Precise answers to such questions are not available, even though much valuable information is.

This paper summarizes what is known and can be predicted about the availability of beech in the Northeast: its location, its volume, its quality.

Most of the data for this report were derived from the Forest Survey, which is a study of the region's timber resources being conducted in the Northeast by the Northeastern Forest Experiment Station. These data are reliable for relatively large areas, such as states or groups of states, but unfortunately they do not provide information on timber in particular localities or individual stands. Nevertheless,

they provide the best statistical information available and offer helpful leads on measuring the availability of beech in the Northeast. Additional information on beech can be found in the other published reports in this Beech Utilization Series.

OCCURRENCE OF BEECH

American beech is found throughout the eastern United States and Canada, from Nova Scotia to northern Florida, and westward to Texas and Ontario. However, the commercial range of beech is rather restricted; more than half of this country's standing beech timber inventory is located in the 12 Northeastern States--the region with which this paper deals.

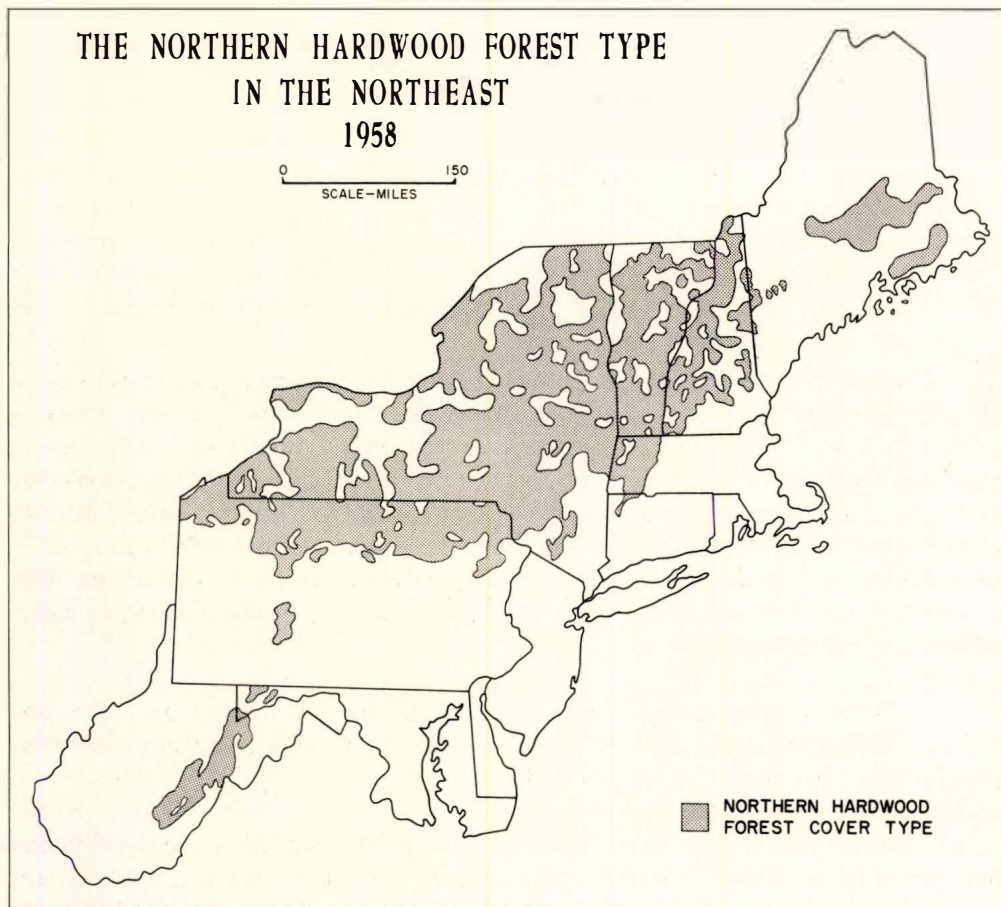


Figure 1.--Ninety percent of the beech sawtimber in the Northeast is found within the confines of the northern hardwood forests.

Beech grows under a wide range of site conditions. It is almost always found in mixture with other species. Its most common associates are yellow birch and hard maple, with which it forms the common maple-beech-birch or northern hardwood forest type. The location of the northern hardwood type (fig. 1) is a good guide to beech sites, for 90 percent of the region's beech sawtimber is in this type.

THE NORTHEAST'S INVENTORY OF BEECH

Beech in the region's forests represents an inventory of raw material for present or future use. The quality requirements of a product determine what part of that inventory is of value to any particular industry. Thus, in this report, the inventory of beech will be evaluated as to its suitability for sawtimber and for pulpwood.

That part of the inventory which meets sawtimber specifications is suitable for conversion into lumber and similar products, such as containers, timbers, and cross-ties. Sawtimber specifications are also a rough guide to the suitability of the beech inventory for veneer manufacture. Similarly, that part of the inventory which meets pulpwood specifications is suitable for manufacturing pulp and is probably well suited for making mine timbers, fiberboard, and wood particle board. The amount fit for charcoal or fuelwood would include much more material.

Sawtimber

Sawtimber trees are those of commercial species that have a d.b.h. (diameter breast high) of 11.0 inches or larger (hardwoods) and contain at least one sawlog that meets minimum log-grade specifications (see Appendix). The volume of beech in the Northeast that meets these specifications totals almost 9 billion board-feet--a sizable resource.

The distribution of this volume among the Northeastern States is indicated in table 1. Most of the beech volume is located in Vermont, New York, Pennsylvania, and West Virginia. Together, New York and West Virginia have 55 percent of the region's supply of beech sawtimber.

Table 1 also illustrates that beech in the Northeast grows primarily in mixture with yellow birch and hard maple--the northern hardwood forest type. A small volume of beech is also found in the coastal areas, where other spe-

cies dominate the mixture and form the basis for other forest-type classifications.

Table 1.--Net volume of beech sawtimber in the Northeast,
by states and forest type, 1956¹

Region and state	Beech in all forest types	Beech in northern hardwood forest type	
	<u>Million bd.-ft.</u>	<u>Million bd.-ft.</u>	<u>Per- cent</u>
<u>New England</u>			
2 Maine	335	--	--
New Hampshire	687	575	84
Vermont	1,036	1,007	97
Massachusetts	77	69	90
Rhode Island	(3/)	(3/)	(3/)
Connecticut	48	3	6
<u>Middle Atlantic</u>			
New York	3,136	3,078	98
New Jersey	29	3	10
Delaware ⁴	37	(3/)	(3/)
Pennsylvania	1,611	1,417	88
Maryland	185	4	2
West Virginia	1,813	1,308	72
Total	8,994	--	--

¹Volume on commercial forest land only. Volumes are log scale, International 1/4-inch rule.

²Sewall report, adjusted. Sewall Company, Old Town, Maine. Forest Survey estimates not yet available.

³Less than 0.5.

⁴1957 data.

If stands have too few sawtimber trees, they cannot be harvested economically. Those that can be--sawtimber stands--contain at least 1,500 board-feet per acre in sawtimber trees. Thus all sawtimber trees in such sawtimber stands are considered economically operable, and this is the part of the total beech inventory currently available for harvesting as sawtimber on a practical basis. More than 90 percent of the region's 9 billion board-feet of beech is in sawtimber stands, so only a small proportion of the inventory is lost because it occurs in stands of low volume.

Beech's common associates, yellow birch and hard maple, have physical properties similar to those of beech. For this reason, and because the actual volume of any one of these species in a given stand may be rather low, all three species are commonly logged together in a single operation. This is usually the case whether the stand is being cut for sawlogs, turning stock, pulpwood, or fuelwood. Thus, to a considerable degree, the operability of a stand for beech depends upon the volume present of these other species, which ordinarily are considered more valuable. Table 2 shows the distribution of sawtimber volume among these common associates in the northern hardwood type.

Table 2.--Distribution of sawtimber volume¹ in sawtimber stands of the northern-hardwood forest type, by species and state, 1956

Region and state	Net volume of all species		Distribution by species			
	Total	Per acre	Beech	Birch	Maple	Other
	Million bd.-ft.	Thousand bd.-ft.	Per- cent	Per- cent	Per- cent	Per- cent
<u>New England</u>						
Maine ³	--	--	--	--	--	--
New Hampshire	2,340	4.7	19	28	21	32
Vermont	4,591	4.4	19	19	32	30
Massachusetts	519	4.6	10	11	20	59
Rhode Island	(4/)	(4/)	--	--	--	--
Connecticut	256	3.9	1	12	4	83
<u>Middle Atlantic</u>						
New York	14,871	5.6	19	14	31	36
New Jersey	92	4.2	4	8	(4/)	88
Delaware	(4/)	(4/)	--	--	--	--
Pennsylvania	5,333	3.8	22	3	17	58
Maryland	65	3.2	6	2	26	66
West Virginia	4,531	5.1	31	13	15	41

¹International 4-inch rule. • on commercial forest land only.

²Hard maple only. Soft maple listed under "other" species.

³Data from Forest Survey of Maine not yet available.

⁴Quantity too small to be recorded.

Several other factors influence the usefulness of this large sawtimber inventory. To produce high-value lumber or veneer at relatively low cost, available volume should be in large, high-quality trees. Forty percent of the volume of beech sawtimber in the Northeast is in trees larger than 17.0 inches d.b.h. (table 3). In fact, in the states south

of New York, one half the sawtimber volume is in these larger trees. Trees of this size are also large enough to produce one or more veneer bolts. (Of course veneer logs have other quality requirements besides size).

Table 3.--Distribution of beech sawtimber volume
by diameter classes and states, 1956¹

(In million board-feet)

Region and state	D.b.h. class, in inches					
	12	14	16	18	20	Total
<u>New England</u>						
Maine ²	77	67	60	41	90	335
New Hampshire	184	174	124	106	99	687
Vermont	240	234	265	171	126	1,036
Massachusetts	23	29	15	10	(3/)	77
Rhode Island	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
Connecticut	12	7	6	(3/)	23	48
<u>Middle Atlantic</u>						
New York	605	718	678	533	602	3,136
New Jersey	14	7	8	(3/)	(3/)	29
Delaware ⁴	19	18	(3/)	(3/)	(3/)	37
Pennsylvania	370	342	240	224	435	1,611
Maryland	21	17	46	17	84	185
West Virginia	194	229	336	256	798	1,813
Total	1,759	1,842	1,778	1,358	2,257	8,994

¹On commercial forest land only. Volumes are log scale, International 1/4-inch rule.

²Sewall Company report, adjusted.

³Less than 0.5.

⁴1957 data.

But what about quality? An estimate of the distribution of beech sawtimber volume by hardwood-lumber log grades and hardwood-tie-and-timber log grades is available from Forest Survey data for all Northeastern States except Maine. (See figures 2 and 3 for specifications.) This information (table 4) shows that only 30 percent of the beech volume would meet the specifications for Grade I or Grade II hardwood lumber logs. Despite the somewhat smaller trees, it is interesting to note that, as compared with the rest of the region, the New England States and New York have a somewhat higher proportion of beech volume in the upper log grades.

Table 4.--Quality of beech sawtimber for lumber, tie, and timber production, by states, 1956¹

Region and State	Log Grade I		Log Grade II		Log Grade III		Tie & Timber Logs		Total
	Million bd.-ft.	Per- cent	Million bd.-ft.	Per- cent	Million bd.-ft.	Per- cent	Million bd.-ft.	Per- cent	Million bd.-ft.
<u>New England</u>									
Maine ²	--	--	--	--	--	--	--	--	--
New Hampshire	41	6	138	20	364	53	144	21	687
Vermont	145	14	246	24	436	42	209	20	1,036
Massachusetts	7		13		55		50		125
Rhode Island									
Connecticut									
<u>Middle Atlantic</u>									
New York	488	16	632	20	1,587	50	429	14	3,136
New Jersey	12		39		85		78		251
Delaware									
Maryland									
Pennsylvania	101	6	167	10	755	47	588	37	1,611
West Virginia	314	17	291	16	638	35	570	32	1,813

¹On commercial forest land only. Volumes are log scale, International ¼-inch rule. Grades used are for hardwood lumber and tie and timber logs (see Appendix).

²Forest Survey data not yet available for Maine.

Pulpwood

Much of the Northeast's inventory of beech is also suitable for pulpwood and similar products. For pulpwood, essentially the same inventory is included as was considered for sawtimber, but different standards are applied. Practically all of the region's beech sawtimber meets minimum pulpwood specifications; but in addition a large part of that inventory too small for sawtimber is suitable for pulpwood.

There are 39 million cords of beech growing stock in the Northeast that meet minimum pulpwood specifications.¹ Among states for which pulpwood inventory data have been collected, the distribution of this volume is as follows:

	<u>Cords</u>
Mass., Conn., R. I.	900,000
New York	12,140,000
Pennsylvania	7,440,000
Md., Del., N. J.	760,000

¹This estimate was made by applying the average relationship of pulpwood volume to growing-stock volume, for the states for which data are available, to the region's total beech growing-stock volume.

All of this volume is on commercial forest land and thus is at least tentatively "available". Some of it might temporarily be retained by landowners as growing stock for the production of future sawtimber. However, this proportion is probably not large, because usually landowners will prefer to retain the associated hard maples and yellow birch.

The volume of usable wood per acre affects the practicality of the harvesting of pulpwood in much the same way it does the cutting of sawlogs for lumber. Assuming that 5 cords per acre is the minimum volume that can be removed economically, then over 90 percent of the volume of beech pulpwood in the region is in stands that are operable for pulpwood.

Table 5.--Distribution of growing-stock volume in the northern-hardwood forest type, by stand-size class, species, and state, 1956

State	Net volume of all species		Distribution by species			
	Total	Per acre	Beech	Birch	Maple ¹	Other
	<u>Million</u> <u>cu. ft.</u>	<u>Thousand</u> <u>cu. ft.</u>	<u>Per-</u> <u>cent</u>	<u>Per-</u> <u>cent</u>	<u>Per-</u> <u>cent</u>	<u>Per-</u> <u>cent</u>
SAWTIMBER STANDS						
Maine	--	--	--	--	--	--
New Hampshire	771	1.6	20	25	20	35
Vermont	1,731	1.7	19	18	32	31
Massachusetts	254	2.2	10	12	23	55
Rhode Island	(2/)	(2/)	--	--	--	--
Connecticut	115	1.7	1	16	10	73
New York	4,568	1.7	18	13	31	38
New Jersey	38	1.7	2	16	(2/)	82
Delaware	(2/)	(2/)	--	--	--	--
Pennsylvania	2,028	1.5	17	7	22	54
Maryland	37	1.8	8	2	23	67
W. Virginia	1,587	1.8	27	13	14	46
POLETIMBER STANDS						
Maine	--	--	--	--	--	--
New Hampshire	513	1.0	12	18	25	45
Vermont	506	.8	9	13	40	38
Massachusetts	197	.8	10	16	17	57
Rhode Island	(2/)	(2/)	--	--	--	--
Connecticut	33	.8	2	23	24	51
New York	1,650	.9	10	7	24	59
New Jersey	3	.4	--	--	10	90
Delaware	(2/)	(2/)	--	--	--	--
Pennsylvania	1,954	1.0	10	9	15	71
Maryland	42	.8	3	3	30	64
W. Virginia	532	1.1	13	11	9	67

¹Hard maple only. Soft maple listed under "other" species.

²Quantity too small to be recorded.

The species distribution of the growing-stock volume in the northern hardwood type is shown in table 5. (See appendix for definitions of growing stock and other terms.) Note the lower proportions of beech, birch, and hard maple in the poletimber stands.

THE CHANGING SCENE

But forest inventories represent more than a fixed stock of raw materials to be converted immediately into primary forest products. Forests grow. Thus, although to the pulpwood industry young stands represent a raw-material inventory, to the lumber or plywood industries young stands are only prospective inventories--inventories in the process of being produced.

The rate at which the inventory of any particular type of stumpage increases or decreases is a function of the rate of net growth and the rate of cutting. Net growth is affected by how fast individual trees increase in size and by how fast insects, disease, fire, and forest competition cause defect, cull, and mortality. The rate of cutting depends on business conditions and other factors, as well as on the species preferences of the wood-using industries.

Industrial preference for its associated species and the ability of beech to reproduce itself so effectively are partially responsible for a commonly accepted belief that the proportion of beech in Northeastern forests is increasing. However, the beech scale-Nectria complex is a major offsetting factor.²

From Forest Survey data, wood-use information from State sources, and the knowledge of men who are closely associated with the region's wood-using industries, estimates of recent rates of cutting and of the growth of beech were derived. In the 12-state area, beech growing stock is currently being harvested at a rate of about 45 million cubic feet per year; current net growth of growing stock is approximately 120 million cubic feet per year. Thus the volume of beech grown annually is almost three times the volume being cut, a relationship which supports the idea that the volume of beech in the Northeast is increasing.

²Crosby, David, and Bjorkbom, J. C. Timely salvage can reduce losses from beech scale-Nectria attack. U. S. Forest Serv. Northeast. Forest Expt. Sta. Forest Res. Note 82. 4 pp. 1958.

Although this growth-cut ratio differs from one locality to another, growth is greater than cut in every state where beech is important. The greatest differential, both absolutely and relatively, appears to be in West Virginia.

IN SUMMARY

There is a large quantity of beech timber in the Northeast that meets the requirements of sawtimber, pulpwood, and other prospective timber uses. This inventory is increasing; beech is growing more rapidly than it is being cut. Thus this beech resource is capable of satisfying the appetite of a considerably more voracious beech-consuming industry than now exists. Increased consumption of beech in the smaller diameter classes would be particularly beneficial to the economy of the region. An exceptionally large quantity of material of this size is currently available, and much of it could be removed as thinnings. This could consequently release beech's associated species that are exceptionally valuable for sawtimber and veneer.

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APPENDIX

DEFINITIONS OF TERMS

Commercial forest-land area.--Forest land that is (a) producing, or physically capable of producing, usable crops of wood (usually sawtimber); (b) economically available now or prospectively; and (c) not withdrawn from timber utilization through statute, ordinance, or administrative order.

Northern hardwood forest cover type.--Forests in which 50 percent or more of the stand is sugar maple, beech, or yellow birch, singly or in combination, on the basis of cubic-foot volume for sawtimber and poletimber stands.

Sawtimber trees.--Trees of commercial species that contain at least one merchantable sawlog as defined by regional practice and that are of the following minimum diameters at breast height: softwoods 9.0 inches, hardwoods 11.0 inches. (A merchantable sawlog is a portion of a live tree that meets the minimum log-grade specifications, as defined under log-grade classification.)

Poletimber trees.--Trees of commercial species that meet regional specifications of soundness and form, and are of the following diameters at breast height: softwoods 5.0 to 9.0 inches, hardwoods 5.0 to 11.0 inches. (Such trees will usually become sawtimber trees if left to grow.)

Cull trees.--Live trees of sawtimber or poletimber size that are unmerchantable for sawlogs now or prospectively because of defect or rot, or because they are of undesirable species.

Sawtimber stands.--Stands with sawtimber trees having a minimum net volume per acre of 1,500 board-feet, International $\frac{1}{4}$ -inch rule.

Poletimber stands.--Stands failing to meet the sawtimber stand specification but at least 10 percent stocked with poletimber and larger trees (5.0 inches d.b.h. and larger) and with at least half of the minimum stocking in poletimber trees.

Growing stock.--Net volume, in cubic feet, of live sawtimber trees and live poletimber trees from stump to a minimum 4-inch top (of central stem) inside bark.

Sawtimber volume.--Net volume in board-feet, International $\frac{1}{4}$ -inch rule, of live sawtimber trees of commercial species.

Net volume in cubic feet.--Gross volume in cubic feet, less deductions for rot.

Standard cord.--A unit of measure for stacked wood, encompassing 128 cubic feet of wood, bark, and air space. Cord estimates are derived from cubic-foot measurements by applying a factor of 80 cubic feet of wood (without bark) per rough cord.

Net volume in board feet.--Gross volume in board-feet (log scale, International $\frac{1}{4}$ -inch rule) less deductions for rot, sweep, and other defects affecting use for lumber.

LOG GRADES

Log grades used are outlined in figures 2 and 3.

PULPWOOD SPECIFICATIONS

Source of Specifications

The pulpwood specifications used in this report are those set up by the Appalachian Technical Committee of the American Pulpwood Association.

Pulpwood Trees

Live trees of commercial species, 5.0 inches d.b.h. and larger, containing at least two contiguous pulpwood bolts and with 50 percent or more of the main-stem volume usable for pulpwood. (A pulpwood bolt is a section of the main stem 4 feet long; 4.0 inches or larger inside bark at the small end; free from any indication of rot, charred wood, metal, or hollow center; and contiguous to one or more other bolts that meet the same requirements. Crotches are excluded; sweep or crook in any section shall exclude the bolt if a line from center of top cut to center of bottom cut passes outside the wood at any point.)

HARDWOOD LUMBER LOGS

GRADE FACTORS *		SPECIFICATIONS						
		Log Grade 1			Log Grade 2			Log Grade 3
Position in tree		Butts only	Butts & uppers		Butts & uppers			Butts & uppers
Minimum diameter (inches)		¹ 13-15	16-19	20+	² 11	12+		8+
Minimum length (feet)		10+	10+	10+	10+	8-9	10-11	12+
Clear cuttings *** on each of the 3 best faces	Min. length (feet)	7	5	3	3	3	3	2
	Max. number	2	2	2	2	2	2	--
	Min. yield in face length	5/6	5/6	5/6	2/3	3/4	2/3	2/3
Max. sweep and crook allowance (percent of gross volume)		15			30			50
Max. cull and sweep allowance (percent of gross volume)		³ 40			⁴ 50			50
*** A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth the surface of the log as divided lengthwise.		¹ Ash and basswood butts can be 12 inches if otherwise meeting requirements for small No. 1's. ² 10-inch logs of all species can be No. 2 if otherwise meeting requirements for small No. 1's. ³ Otherwise No. 1 logs with 51-60 percent cull can be No. 2. ⁴ Otherwise No. 2 logs with 51-60 percent cull can be No. 3.						

Figure 2.--Standards used for grading hardwood lumber logs, including beech, in the Forest Survey of the Northeast.

Pulpwood Volume

Net volume in standard cords (including bark) of the main stems of pulpwood trees, from stump to point where the top breaks up into branches or to a minimum top diameter of 4.0 inches (inside bark). Deductions are made for all portions of the stem that fail to meet pulpwood bolt requirements.

TIE AND TIMBER LOGS

GRADE FACTORS		SPECIFICATIONS
Position in tree		Butts and uppers
Scaling diameter (inches)		8+
Length, without trim (feet)		8+
Clear cuttings		No requirements: not graded on cutting basis.
Max. sweep allowance		One-fourth d.i.b. of small end for half logs, and one-half d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if none has an average collar* diameter that is more than one-third of log diameter at point of occurrence
	Whorled knots	Any number, provided the sum of the collar diameters does not exceed one-third the log diameter at point of occurrence.
	Holes	Any number not exceeding knot specifications if they do not extend more than 3 inches into the contained tie or timber.
Unsound surface defects permitted **	Any number and size if they do not extend into contained tie or timber. If they extend into contained tie or timber, they shall not exceed size, number, and depth of limits for sound defects.	

* Knot collar is the average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

** Interior defects are not visible in standing trees. They are considered in grading cut logs. No interior defects are permitted except one shake not more than one-third the width of the contained tie or timber, and one split not more than 5 inches long.

Figure 3.--Standards used in the Forest Survey of the Northeast for hardwood tie and lumber logs, including beech.

(CONTINUED FROM INSIDE OF FRONT COVER)

- * Chemistry and chemical utilization of beech.
- * Silvicultural characteristics of beech.
- * Availability and supply of beech.
Present markets and uses for beech.
- * Logging beech and specifications for products.
- * Seasoning beech lumber.
- * Storage of beech logs and bolts.
- * Machining of beech.
- * Milling of beech.
- * Gluing techniques for beech.
- * Steam-bending of beech.
Preservative treatment of beech.
- * Beech for flooring.
Beech for furniture.
- * Beech for turned products and novelties.
- * Beech for veneer and plywood.
- * Beech for fuel and charcoal.
- * Beech for crossties.
- * Beech for containers.
- * Pulping and defiberization of beech.
- * Rough construction on the farm with beech.

The Northeastern Station acknowledges gratefully the effort being devoted to these problems by the many agencies and individuals who are cooperating in this project. Among the leaders in it are David B. Cook, New York State Conservation Department; Claude Bell, U.S. Forest Products Laboratory; A. H. Bishop, State University of New York, College of Forestry; and Fred Wangaard, Yale University School of Forestry. These men, along with Fred C. Simmons and C. R. Lockard of the Northeastern Station, comprise the working committee that is directing and coordinating the project.

The information gathered in this widespread cooperative project should be of great use to the wood-using industries of the regions where the wood of American beech is available.

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